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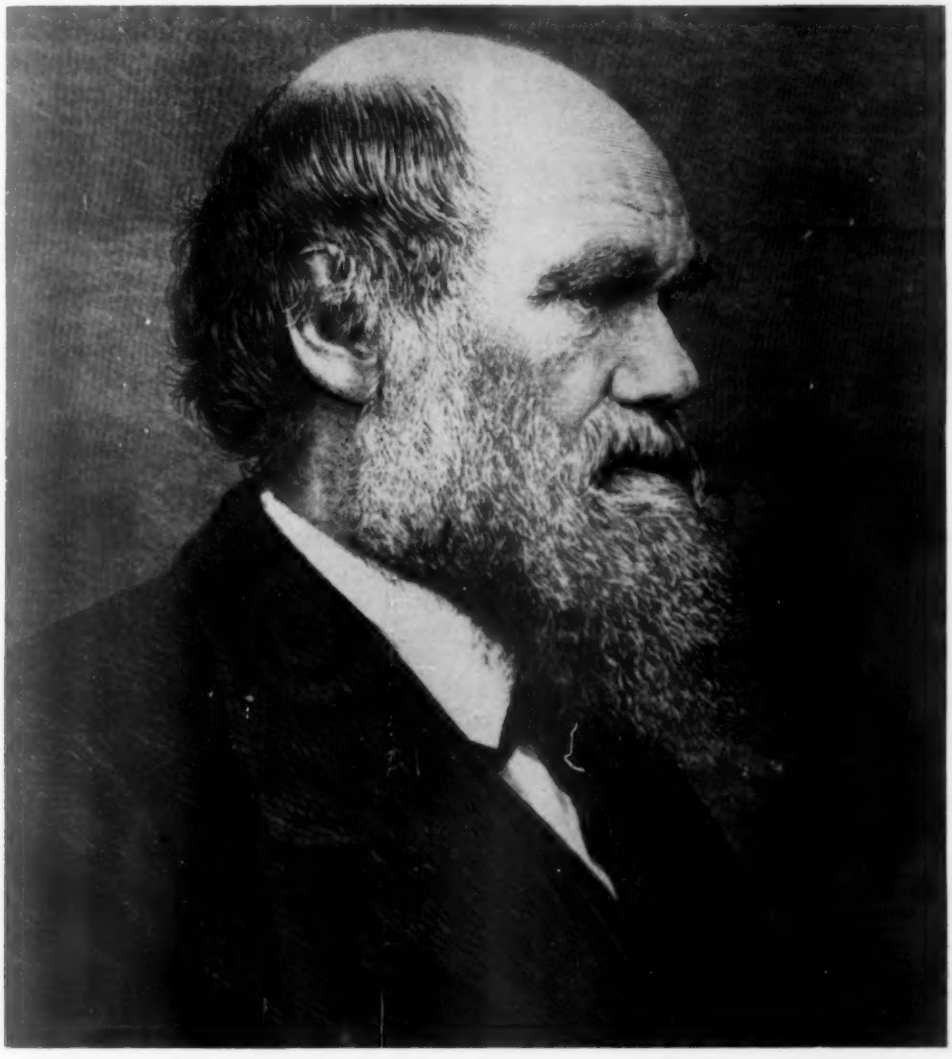
The American Biology Teacher

NOVEMBER, 1958 VOLUME 20, NO. 7



Charles Darwin

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Mammal Skin Preparation

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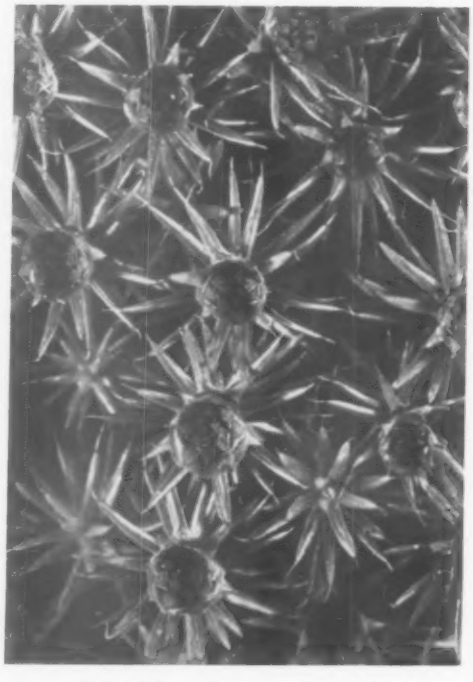

Polytrichum Moss: antheridial plants at left, and plants with sporophytes at right.

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Cover Photograph

The editorial staff of the ABT is pleased to publish a picture of Charles Darwin on the cover this issue. We are honored also to present an article about Charles Darwin, written by his grandson, Sir Charles Darwin, an eminent British scientist. As you know, the centenary of the publication by Charles Darwin of the theory of evolution by natural selection, occurs this year.

THE AMERICAN BIOLOGY TEACHER

Publication of the National Association of Biology Teachers.

Issued monthly during the school year from October to May. Second class postage paid at Danville, Illinois.

Publication Office—Interstate Press, 19 N. Jackson St., Danville, Ill.

Co-Editors—RICHARD ARMACOST, Department of Biological Sciences, Purdue University, West Lafayette, Ind.; PAUL KLINGE, Coordinator for School Science, Indiana University, Bloomington, Indiana.

The Purdue University address will be the official editorial office. Manuscripts and all publication material may be sent to either of the Co-Editors.

Managing Editor—MURIEL BEUSCHLEIN, 6431 S. Richmond, Chicago 29, Ill.

Subscriptions, renewals, and notices of change of address should be sent to the Secretary-Treasurer, PAUL WEBSTER, Bryan City Schools, Bryan, Ohio. Correspondence concerning advertising should be sent to the Managing Editor.

Annual membership, including subscription, $3.75, subscription to Journal, $3.75, individual copies, $.50, outside United States, $4.50, individual copies, $.50.

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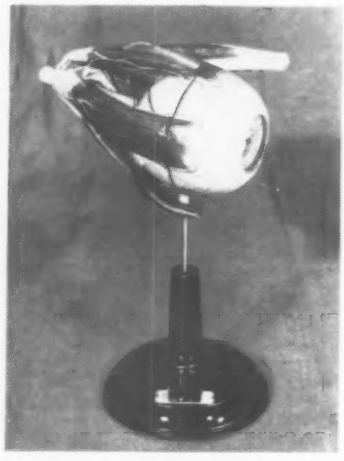

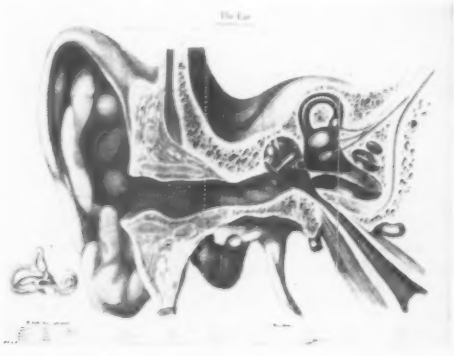

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Charles Darwin: Man and Scientist

SIR CHARLES DARWIN
Fellow of the Royal Society (London)

This is the centenary year of the first publication of the theory of evolution by natural selection, which is now generally accepted as giving the main account of the development of life on our Earth. It was first published in papers read to the Linnaean Society of which the authors were Charles Darwin and Alfred Russel Wallace, and these papers have a curious origin.

Darwin first got the germ of the idea in 1835, more than 20 years earlier, when he was acting as naturalist on the surveying voyage of the Beagle, a ship of the Royal Navy which spent five years mainly around the coasts of South America. It was a revolutionary idea at that time, involving many difficulties, and he was very cautious about putting it forward.

Two Notes on an Idea

There survives a short note about it which he made in 1842, and another rather fuller one in 1844, at the end of which he wrote the request that in the event of his death it should be published. But having done this he settled down quietly and spent the next 17 years in working out the details, with no thought of publishing anything till his theory should be complete.

In the generally accepted theory of those days each species of animal or plant was supposed to have been separately created, though, of course, nobody had any clear idea how this creation happened. In fact, however, various previous writers had also seen that the resemblances between different kinds of animals might be most easily explained if they were descended from a common ancestor, having each been modified from the ancestor in different ways.

One of the chief people to propose this idea was Charles Darwin's own grandfather Erasmus, a prominent physician in the 18th century, who was also counted as a considerable poet in those days, though no-one thinks much of his poetry now. The difference between these earlier writers and Charles was that they did not explain why the animals should have changed, and his contribution was to explain how this came about. It was by the perpetual struggle for life which all animals and plants experience; only the really efficient ones survive and the weaker and less successful ones are extinguished without leaving offspring.

Continuous Gradations Must Exist

This idea gave him plenty to do, because there must be continuous gradations between every animal and its ancestors produced by small variations in the qualities each had inherited from its parents. If there were any single case where such gradations could be seen to be impossible, then the whole theory would fail.

In addition he had to study the struggle for life, which is the mechanism that selects which variations will succeed. This it does by continually holding all animals up to the mark, and in the course of doing so it improves them. Much of this work was done by a detailed study of the writings of others, but quite a lot of it was done by himself in his own garden at Down House.

I know this garden well, because though my grandfather died five years before I was born, my grandmother lived on there till her death when I was about ten years old, and I used to spend much of the summer there during those years. Down House is in Kent, actually only about 15 miles from central London, though even to this day it is entirely rural. There has been hardly any change in either the house or the grounds in all these years, and a few of the rooms are now preserved as a museum.

Nature's Ruthlessness Demonstrated

The sort of thing he studied there was the struggle for life between the various animals or plants living together. For example, one experiment he did was to clear the grass off a patch of six square feet and then study what weeds would come up. Out of 357 which did, no less than 295 were destroyed, either by slugs or insects, and this showed the frightful mortality going on all the time among plants.

Another calculation he made was done by counting all the birds' nests in the garden after a rather hard winter, which showed that four-fifths of the birds in the garden had been killed. There were few people in those days who realized the ruthlessness of nature as indicated by such observations as these.

He pursued this kind of work steadily through the years, and was accumulating vast amounts of information to be ultimately published later, when suddenly a crisis occurred.

In 1858 he received a letter from Wallace, a younger man who was engaged in the study of the animals and plants of the Malay peninsula. This letter asked him to send in for publication a theory of evolution that Wallace had made, which proved to be exactly the same as the theory he had himself been working at for twenty years.

What was to be done? At first he thought he would send Wallace's paper in for publication, and give up any claims for himself, but in the end he referred the question to the judgment of two experts in the biological field: Lyell, the leading living geologist at that time, and Hooker, a famous botanist. The referees gave what was undoubtedly the right verdict; that each should give a short paper at the same meeting of the Linnaean Society, and that then each should be free to publish his own work. It is the centenary of these papers that is being celebrated this year.

After that Darwin started to collect together all the information he had taken so long to accumulate, and to turn it into a book. He called this book only an abstract of the great book he had intended to write later on the subject, but it was in fact the "Origin of Species," which has undoubtedly revolutionized the thinking of everybody about life on our Earth.

Studies for Outdoor Laboratories: A New Series

At the Indianapolis meetings, the NABT Conservation Committee and the Editorial Board of *The American Biology Teacher* agreed to launch a series of articles to promote the use of outdoor laboratories by biology teachers.

This series will be the major effort of a sub-committee on Outdoor Laboratories, under the leadership of Dr. Richard L. Weaver, School of Natural Resources, University of Michigan, Ann Arbor, Michigan. *Authors for parts of the series are needed*, and contributions should be sent to Dick Weaver.

Suggestions to Contributors for Outdoor Laboratory Series

Articles should be especially helpful in correlating outdoor laboratory work with current classroom work, supplementing the NABT CONSERVATION HANDBOOK.

A great variety of subjects await authors. Some will want to take an environmental approach, writing on how to study a lawn, foundation planting, or marshy spot behind the ball field. Some will take an organismic approach, describing how to study robin populations, Japanese beetles, or Kentucky bluegrass. Others may take a managerial approach, dealing with agricultural, horticulture, silviculture, or wildlife management as application of biology to the school grounds or to other properties available. Manifold other approaches include such inviting avenues as evolution, genetics, and physiology. Some authors will emphasize descriptive biology and others experimental biology.

Given so much freedom of subject and approach, authors should not object to some editorial regimentation in this series. The following topics are suggested:

SCENE: Name, type, and location of school. Season and duration of study.
PURPOSE: (short and to the point).
CLASSROOM PREPARATION:
OUTDOOR ACTIVITY AND CORRELATED CLASSROOM WORK:
CLASSROOM FOLLOW-UP AND RESULTS:
APPENDIX: LITERATURE, AUDIO-VISUAL AIDS, RESOURCE PEOPLE, EQUIPMENT, MATERIALS.

Authors can help the editors by following suggestions outlined by John Breukelman in "Preparation of Manuscripts for Publication," *The American Biology Teacher* II:7 (174-180), November, 1949. The four pages hold about 2800 words (eight 350-word columns), but it is best to use some of the space for glossy black-and-white photographs and diagrams of apparatus, maps, and other line drawings combining instruction and decor—Start writing! !

Outdoor Laboratory Series—Number 2

The Wet-Pine-Barren—A Habitat in Miniature*

MALVINA TRUSSELL

Professor of Science Education, Florida State University, Tallahassee, Florida

Liberty Hyde Bailey in his "Nature Study Idea" tells the story of a child who was asked if she had ever seen the great dipper. "Oh, yes, she replied, 'I saw it in my geography.'" Bailey, in commenting on this method of observation, says: "This is better than not to have seen it at all; but the proper place to have seen it is in the heavens."

When one observes the enthusiasm these teachers manifest as they see natural objects in the proper environment for the first time, one realizes that the secret of interesting people in nature study is in putting them in contact with the natural environment. A teacher who had taught 30 years at the edge of the Okefenokee swamp said to me one morning: "Yesterday I looked at a mocking bird perched on a telephone wire. That was the first time in my life I ever looked at a bird to see what it was." You may feel this is an isolated case. It is not. We are not aware of the condition, since few people admit having looked at an object for forty years and never to have seen it. I was showing pictures and discussing some of the interesting bog plants which grow in abundance along the road between Tallahassee and Sopchoppy, Florida. After my talk, a professor's wife who taught at Sopchoppy said: "I traveled that road twice a day—70 miles daily—five days a week for nine months and never saw a single plant you showed this evening." Much of the time, she had probably been moving at 60 miles per hour, a speed which affords little opportunity for noting plants as spectacular as the Loblolly-Bay (*Gordonia Lasianthus*) or as flashy as the Fever-tree (*Pinckneya pubens*). Today, when one slows down to as little as 30 miles per hour on a modern highway an accident builds up in the form of ten or more cars with each driver rapidly reaching the explosive stage. We speed up, and find ourselves envying the early naturalists in having modes of travel limited to walking, horseback riding and man-propelled boats.

In the present day of speed and crowded schedules, we must do something to inspire people to stop or at least slow down enough to see their natural environment as an interesting, meaningful mosaic. If we can introduce them to one specific habitat, I believe they will begin to associate the brilliant fall colors of the scrub oak with the infertile sand ridges found along the roadsides; new growth of persimmon and sassafras will call to mind the fallow field on which they grow best; the tall yellow trumpets of the yellow pitcher plant will convey a message that sundews, butterworts, bladderworts and the flat-growing Lycopodium can be found if one has the time to take a closer look.

Today with the crowded schedules and classrooms of high schools and colleges, one has little opportunity during school hours to do fieldwork involving more than one or, at the most, two hours. As a consequence, most high school and college teachers limit their firsthand experiences to activities such as: dissecting the flower of a hibiscus; splitting a carrot root; sprouting bean seeds between blotters; dissecting a preserved fish; and studying the anatomy of a frog which was collected alive in Florida, shipped to a supply house in Chicago and returned in formalin to a biology laboratory less than 500 yards from the spot where the same frog sounded forth his mating call the preceding spring.

As I try to face these facts of life, I am reminded that Liberty Hyde Bailey, 34 years ago, was concerned about the speed at which the world was moving. In "The Outlook to Nature" he said: "Civilization has led us away from the morning, and at the same time it has led us away from youthfulness. We have telescoped the day far into the night, and morning is becoming obsolete. I know that this

Palmetto scrub—Too much competition for wet-pine-barren plants.

A typical burned-over area—crown burn of most pines. Abundant sunshine, plus lack of competition from woody plants, makes for a lush growth of wet-pine-barren plants.

Concrete area before soil and plants are brought in.

cannot be helped; but it can be mentioned. I have asked person after person whether he ever saw the sun rise. The large number have said no; and most of those who had seen the sun rise had seen it against their will and remembered it with a sense of weariness."

I would like to mention one possible solution to our dilemma: bring the habitat to the schoolyard. In my attempt to do this, I have experimented with a wet-pine-barren which can be developed on any school ground or even in a small backyard as I have done. I have grown at least fifty species of bog plants in an area fifteen feet long and not more than four feet at its widest part, with a depth varying from five to ten inches. I have used a cement bottom and sides to simulate the hardpan which prevents drainage in the natural wet-pine-barren. I have duplicated the soil conditions, in some instances, bringing in soil from the natural habitat.

There are certain advantages in studying a wet-pine-barren in miniature: (1) it is not necessary to travel 30 miles to the nearest natural habitat so as to keep records of blooming periods or get pictures when the blooming is at its best; (2) it is not necessary to don hip boots when you can straddle the width, and walk around the sides of your miniature habitat; (3) you do not need a hale companion to pull you out when suddenly you find yourself knee deep in the most viscous material one can imagine. If this can happen to legs with big feet attached, imagine what happens to the slender legs of a tripod, especially when the consistency of the terrain varies at each point of the basal triangle. (4) You can avoid some of the weather hazards. Dwellers of wet-pine-barrens love areas not only flooded with water but with sunlight as well. They always seem to be situated between breeze barriers and are at their best during June, July and August, the hottest months of the year. But before you decide against studying this engaging habitat, I want to assure you there are many advantages—no poison ivy, sandburs, sticktights or mosquitoes.

I became interested in the wet-pine-barrens many years ago as I explored them with nature study classes in Southeast Georgia. The time was when one could travel the coastal highways of Georgia and revel in the glory of the tall yellow pitcher plant (*Sarracenia flava*) stretching for miles along the highway. We even had a couple of acres of the college campus covered with these strikingly beautiful plants. Field trips were no problem in those days. Alas, it has now been drained and exotic plants occupy the spot where dozens of species of bog plants once thrived.

Surprisingly enough, some of our present day conservation practices are chiefly respon-

The large yellow pitcher plant (*S. flava*) open bogs.

Drummond's pitcher plant.
Sarracenia Drummondii

Whitetop Sedge
Dichromena latifolia

sible for the rapid disappearance of the wet-pine-barren. In the days when cattle "ran the range" a farmer's pasture was the whole out-of-doors. In order to make early grazing possible the wooded areas and roadsides were burned over in the late winter leaving the area a desolate picture. But soon the area was a scene of beauty. The fruiting bodies of the cinnamon fern seemed to spring up over night. Basal rosettes which were covered by water took on new life and various species of colic root, ladies tresses, hat pins and butterworts sent up their slender flower stalks.

For survival, the plants of the wet-pine-barren must have abundant sunlight; they have little chance when placed in competition with shade making trees, shrubs and scrub palmettos. The herb-like plants of this habitat place their stems underground, out of reach of the flames and survive the annual fires, while the shade making trees, shrubs and palmettos are killed or severely dwarfed. Members of the family *Hypericaceae*, the sweet bay (*Magnolia Virginiana*), and the swamp gum (*Nyssa biflora*) are among the few hardwood plants able to survive the annual fires even in a dwarfed condition.

The second factor which is destroying the wet-pine-barren as a habitat is drainage. One of the features of this habitat is a waterlogged mineral soil. Several factors, including restricted root growth, conspire to form a hard-pan which prevents proper drainage of the soil. With the discovery that southern pines could be used for paper and a variety of synthetics, the low areas of the gulf coast were drained so that pines could make a start. Because of the soil conditions which had developed through the years, the bog plants hold on for a period of time, but as the pines increase in number, naturally or from planting, the sun-water loving plants disappear.

Possibly the last stronghold of the wet-pine-barren is the shallow ditch along the side of the road. One can still drive along a few secondary roads and see the light reflected by the dew-like sticky fluid on the narrow leaved sundew (*Drosera filiformis*), giving it the name Dew-threads; the white-flags of the white-topped sedge (*Dichromena latifolia*); the dainty pink meadow beauty (*Rhexia mariana*); the many species of marsh pink (*Sabbatia* sp.); the unusual Drummond's pitcher plant (*Sarracenia Drummondii*); the grass pink orchid (*Colopogon pulchellus*); and the pink flowered sundew (*Drosera capillaris*). Even the swamp-loving trees grow to the edge of these shallow ditches: the showy loblolly bay (*Gordonia Lacianthus*) blooms from March through the summer months; the shrub-like buttonbush (*Cephalanthus occidentalis*); and the conspicuous fever-tree (*Pichneya pubens*).

Roadside ditch filled with bog plants

Roadside ditch filled in and mowed biweekly.

The edges of these ditches appear to be the last stronghold of Catesby's lily (*Lilium Catesbaci*), growing slightly above the high water mark. Just below the habitat of the Catesby's lily are the various species of the bunch flower of the genera *Pleea* and *Zygadenus;* we also find a variety of species of *Polygala* —(*P. ramosa, P. cymosa, P. cruciata.*); possibly the most conspicuous herb is the tall orange fringed orchid which blooms in the late summer (*Blephariglottis ciliaria*).

In spite of the persistence of these plants, this last stronghold is rapidly being conquered by the forces of "progress" and roadside "beautification." First comes the giant bulldozer to fill in the low, wet areas. Then comes the road scraper to level off the shoulders and make them less hazardous for the person traveling 70 miles per hour caring little for the natural beauty of the roadway. Many of the plants are so persistent they survive the bulldozer *and* the road scraper. Soon they put forth slender leaves and showy flowers. But before seed can be produced the road department, thinking in terms of roadside "beautification," begins its biweekly mowing.

This is a dark picture for the survival of the wet-pine-barren as a habitat. Perhaps the bringing of a miniature habitat to the school grounds will stimulate interest in this group and contribute to its survival. From this interest may come a future naturalist to answer some of the questions which have baffled me: Why do the yellow pitcher plants (*S. flava*), the tallest of the species, and the bird-beaked (*S. psittacena*), the least conspicuous since it grows flat on the ground, live together in deep, heavy bogs while Drummond's (*S. Drummondii*) seldom associate with any other species of the genus, and prefers a hard, sand wet-pine-barren? Do the open pitchers of the purple pitcher plant (*S. purpurea*), along with its decumbent habit, account for its infrequent occurrence? Why are certain small families limited to this habitat while a large family, the legumes, is wholly absent? Do we have the final answer to the value of the trapped insects to the plants of the genus *Sarracenia*? Does the low oxygen content of the soil interfere with root growth and its water absorption function hence causing the narrow, appressed leaves found on the stems of most of our wet-pine-barren plants? Why are many of the species limited to the Southeast while others grow equally well in the sand dune area of Chicago? Does our present knowledge of photoperiodism give the answer as to why the beautiful bog cosmos (*Coreopsis nudate*) is found blooming in profusion in early March while most species of this large genus bloom in the late summer and early fall?

These are some of the questions awaiting an answer. Perhaps a wet-pine-barren in miniature may fire the enthusiasm of some students to come up with the answers.

BOOK

SECOND-RATE BRAINS, Kermit Lansner, ed., 96 pp., $1.50, Doubleday & Company, Inc., New York, 1958.

A collection of reprints of current significant speeches and papers on the present educational crisis with an underlying reference to the Russian system throughout. Papers include Bestor, Oppenheimer, and Rickover. Material will be useful for those wishing quotable statements critical of our present educational system.

Preparations of Mammal Skins*

ERNEST LITWEILER,
Adams High School, South Bend, Ind.

Getting Charlie ready
(Photo by Borror Studio)

From zoo to class

I

When mammals die and the souls ascend to heaven, or wherever mammal souls go, what becomes of their early remains?

It is our opinion, that the high school or college biology instructor misses an excellent teaching opportunity if he fails to preserve the skins and the skulls of these animals for the study of mammalogy. This could be a special project for science clubs, entire biology classes, or for individuals working out projects.

It seems to me that biology teachers should be cognizant of the opportunity afforded by the local zoo. Here is a place for the development of good public relations between the science department and the park administration.

Several years ago a news article appeared in the local paper stating that the male lion, Charlie, in the Potowatomi Park Zoo would have to be destroyed because he was becoming rheumatic and sterile. He was to be replaced by a younger male. After a visit to the park superintendent, it was agreed that our Science Club could have the body if we could take care of all the arrangements.

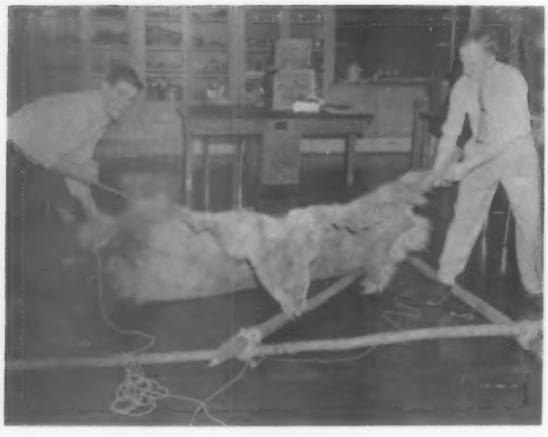
None of the students, nor the instructor, had ever tried a project of this magnitude. After considerable trial and error learning, and with the help of published articles on taxidermy, we finally skinned and mounted the lion, and his head graces the biology lab.

On the opening day of school two years ago, the park personnel reported to our class that the yearling Japanese Sika deer had been pursued by a Barbary sheep and had broken his neck; did we want him? Certain boys volunteered to do the taxidermy work on an individual basis. After skinning the animal and pickling the skin, we mounted the skin on a home-made manikin. The art department at Adams designed a suitable background for this mount and for a number of other animal displays in glass cases.

The most interesting animal in our zoo was Jim, the polar bear. Six years ago we established first claim to him if and when he died. Last year on Thanksgiving Day he drew his last breath. A number of students, including some girls, in the advanced biology class skinned, pickled, and tanned Jim. His beautiful skin now is hanging in the biology classroom. His skull was thoroughly cleaned and is filed in the museum cases with other mammal skulls.

In the study of mammalogy the most interesting procedure, we believe, is to collect

*Presented at the NABT session of the AIBS meetings at Indiana University, August, 1958. Photography by Gallon Miller, Audio-Visual Department, South Bend Public Schools.



Jim needed room to stretch

specimens and prepare the skins as museum mounts. It is well to cooperate with the local game warden if collecting is to be done on a large scale. For mice, chipmunks, shrews, moles, and ground squirrels, there usually are no closed seasons. However, protected mammals may sometimes be caught by mistake.

An area of the playground adjacent to the Adams High School football field has a large population of *Tridecem lineatus*, the thirteen-striped ground squirrel. The burrows often have two entrances.

These animals may be trapped with an ordinary snap-type rat trap, or better still, a museum collector's trap which usually breaks the back without injuring the head or causing undue suffering. The trap is baited with corn meal. In a situation of this kind the percentage of success is quite high. However, in collecting mice, or other Rodentia, a ten per cent success is considered above average.

The external features of the ground squirrel are carefully noted. This species has a large cheek pouch for carrying food into the burrow.

Careful measurements in the metric system are made for the labels. The sex, collector's number and collector's name are placed on the first line of the label. The locality in which the animal was captured on the second line, the county and state on the third line, and on the fourth line the total length of body and tail, the tail, the right hind foot, ear, and the weight in grams. A file card should be kept giving pertinent information about the mammal.

Jim's final resting place

II

The first incision is made with a scalpel on the ventral side. The skin is pulled back and one of the hind legs is pushed through this opening. With a little practice the femur is disarticulated from the tibia and fibula. The flesh is removed from these bones in the lower leg and the bones are wrapped with cotton to assume the same shape as the natural muscles. The other hind leg is treated in a similar manner. By careful manipulation, using the thumb and forefinger, the tail bone may be pulled out. A wire cut to size and wrapped with cotton is then inserted into the tail.

The easy part of skinning is to pull the skin gently over the body and cutting only the adhering tissue as needed. The front legs are treated with the same procedure as that used in skinning the hind legs. The one rule in skinning out the head is to keep cutting against the skull and not toward the skin. The ears are thus cut out and the eyes should not be injured. The final cut across the nose should be through the cartilage. The skin is now inverted—that is, the fur side is inside. The fatty tissue is scraped from the skin and borax is rubbed into the fibers.

Using a fairly large needle and thread the mouth is now sewed from the inside with only three stitches. Cotton is used to form the body. It may be shaped in the same general shape as the mammal's body. Using a forceps, the cotton is held against the nose and the skin pulled back over, now with the fur side out. A soft brush is used to smooth out the hair.

The incision at the abdomen is sewed with a baseball stitch, always starting on the raw

Ready for display

skin side. The animal skin is now placed on the mounting board. The hind legs are stretched out and back, feet down. The front legs are forward and parallel. Mounting pins hold the skin in position so that the skin dries in the desired shape.

The label is attached above the right hind foot in such a way that the strings holding the label will not twist.

A student working on mammal museum mounts of this kind will find that he has embarked upon an interesting hobby. There are thousands of collectors in the United States. Many are anxious to trade mammals skins which are indigenous to their regions. By collecting and trading these mammalogists are able to build a fine collection and build a wealth of knowledge. Indeed, teachers may use skin preparation projects to identify future biologists. If the student holds his nose with disdain, eliminate him. If he uses a scalpel with a gleam in his eye, he may be the student for whom we are searching.

BOOK

How Life Began, Irving Adler, 128 pp., $2.95, The John Day Company, New York, 1957.

A valuable book for every high school science library. Expands the usual textbook offering on the physical and chemical nature of living matter into a readable and an exciting survey of organic chemistry and biochemistry. Terms from DNA to covalent bonds are explained clearly. Every biology teacher will find this an excellent reference for students wishing to go into the chemical aspects of life more thoroughly and some of the modern theories on the origin of life. Each student reader will see how biology is inextricably tied up with chemistry.

Take 'Em Travelling — Biotically!

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The world grows smaller every year, and any live-wire biology student (and some not so alive!) enjoys getting around to see some of it himself. Travel is fun, and informed travel builds a perspective on world values that's hard to acquire any other way.

Most of our general biology students at Stockton College have never seen (some have not heard of) a rain forest, sagebrush desert, or tundra. What's more, a lot of them don't care. But they perk up like magic at a chance to visit these regions—audio-visually! And so, for two weeks each year, through films, film strips, maps, discussion and student research, we roam the world's biomes, driving home, we hope, conservation principles and distribution knowledge in an atmosphere charged with the newness of exploration.

The first week covers the United States; the second week pinpoints unique biota in other regions of the world. The unavailability of biology films on many world areas, and the proximity of U.S. regions, influenced the disproportionate time spread on the U.S. Since our main purpose is to show *visually* the biomes of the world, we build a skeleton of cellulose acetate. This is a filmy unit if ever there was one! The films and sequence vary some from year to year, but our routine runs about as follows:

I. Introduce the Unit

A. *Expressed Aims:* To illustrate the different types of terrain, fauna and flora that a biologically-minded traveler would see on:

1. A zigzag trip across the United States from Washington to the tip of Florida.
2. Trips to other regions of the world.

B. *Unexpressed Aims:* To awaken appreciation and understanding of the interrelations between plants and animals (includ-

ing stress on man) and the varying environments in which they live and struggle the world over. Such appreciation can grow, I believe, only within a mind stimulated to wonder and ponder. We hope to provide the stimuli.

C. *Explain Basic Ecology Terms to Class*

Ecology: The study of the relations of organisms to their environment.

Biome: The largest land community of plants and animals which live in interdependent relation and show an easily recognizable climax vegetation. Samples: grassland, chaparral, deciduous forest.

Ecotone: The transition area between biomes. Sample: where grassland meets deciduous forest and some of each is present.

Fauna: Animals collectively

Flora: Plants collectively

Ecological Equivalents: Organisms which occupy the same ecological niche in similar communities of different biogeographical regions. Sample: Jack rabbit in western U.S.A. Grassland and Patagonian cavy in grassland of Argentina.

D. Draw a large outline map of the U.S. on the Blackboard and Rough in the Major Biomes. (Or use a premade map to point them out, describing features of each.)

Biomes of the United States

(Various references classify U.S. Biomes slightly differently. The following classification works nicely. (from Odum)

Broad-leaved sub-tropical evergreen forest (tip of Florida)
Temperate deciduous forest
Grassland (prairie)
Coniferous forest (Rocky Mts., Sierra)
Tundra
Desert
a. Hot deserts (Creosote bush type of Southwest)
b. Cool deserts (Sagebrush dominated –more northern–Utah, Nevada)
Pinon-Juniper
Chaparral
Moist coniferous forest (Coastal N. Calif., Western Oregon and Wash.)

ECOTONES

Only one ecotone is specifically stressed, to give understanding to the concept.

Deciduous-Coniferous Forest Ecotone (including N. Minnesota and Michigan, New England states, southern Ontario.)

E. Assignment

As an outside assignment, students are asked to color in accurately the major U.S. biomes and the one ecotone listed above, on an 11 x 14 inch desk outline map, and to indicate three animals and three plants found dominantly in each biome. We omit the other ecotones because of the map's size. References useful in this research are listed later.

F. Film Procedures

Two students at a time take turns acting as recorders of the highlights in the films on biomes, thus freeing the rest of the class from note-taking during the films. (Otherwise, some students write notes so steadily they hardly see what's going on on the screen.) After the film, these two students lead a review discussion of the film's essence, spelling names of new animals and plants on the board. This period gives each class member time to jot down his own summary of the biome covered by the film, and information on its flora and fauna. Instructor adds whatever information is pertinent.

II. *Biomes of the U.S.*

A. *Moist Coniferous Forest, Coniferous Forest and Sagebrush Desert.*

We start our trip across the U.S. in the state of Washington, where film number one takes us into parts of three biomes, the Moist Coniferous Forest (also called Temporate Rain Forest) of the Olympic Peninsula, the drier Coniferous Forest of the Cascades, and the Sagebrush Desert of eastern Washington.

Film: Washington and its Natural Resources
30 minutes, sound, color, $2.00
Univ. of Calif. 5270
(U.S. Bureau of Mines)

The film is followed by the student-led discussion mentioned above and supplemented by oral student research reports on animals or plants outstanding to the region, such as: (1) Roosevelt elk; (2) Western red cedar; or (3) Sagebrush–any value?

B. *Chaparral*

Our tour drops south into California's Chaparral Biome.

Film: Chaparral
Sound, color, 17 min. $6.00
Univ. of Calif. 2575
(Arthur Barr Productions
1265 Bresee Ave.
Pasadena 7, Calif.)

This topnotch coverage of the animals and plants and watershed values of chaparral is followed by our usual discussion and reports on wood rat and Toyon, both shown in the film.

C. *Desert*

Walt Disney's color filmstrips carry us into the deserts of the Southwest. From the series of six, time limits us usually to three:

"The Great American Desert"
"Animals of the Desert"
"Reptiles of the Desert"
(Encyclopedia Brittanica Films
Wilmette, Illinois)

D. *Coniferous Forest*

As the expedition turns northeastward, we bump over Sagebrush Desert for miles till the evergreen spires of the Coniferous Forest Biome of the Rocky Mountains darken yonder snowy peaks.

Film Choice:

Mammals of the Rocky Mountains
Sound; color; 11 min. $4.00
Calif. Acad. of Sciences
Glacier Park Studies
Sound; color; 12 min. $5.00
Univ. of Calif. 3963
(Bailey Films, Inc. $4.50)
Canadian Rockies Study
Sound; color; 11 min. $4.50
Bailey Films, Inc.
Yellowstone-Grand Tetons
Sound; color; 22 min. $5.00
Univ. of Calif. 3891
(Bailey Films, Inc. $7.50)

E. *Tundra*

Above timberline in the Rockies, we run into Tundra—just a sample of the biome that stretches for thousands of miles across the Arctic. A good chance to compare biotically climbing a mountain with a trip northward.

Color Filmstrip:

"Tundra"
Life Filmstrips
9 Rockefeller Plaza
New York, N.Y.
Reports: Leming; Muskox; Ptarmigan

F. *Grassland*

Descending the eastern slopes of the Rockies, our biologists wade knee high through the grainlands of the Great Plains states, reliving the days when snorting buffalo, pipe-smoking Redskins, and howling coyotes roamed the tall prairies.

Film Choice:

Grassland
Sd; b & w; $1.00
Univ. of Calif. 2680
Cattle and the Cornbelt
Sd; 20 min. $4.00
Univ. of Calif. 2929
(United World Films)
Reports: American bison

G. *Coniferous-Deciduous Forest Ecotone*

Northward through the Dakotas and into the Quetico-Superior Wilderness of northern Minnesota, the broomstick takes us—to a rendezvous with a canoe and a pack trip into this peaceful Coniferous-Deciduous Forest Ecotone, where we join hands with Canada over a thousand lakes.

Film:

Wilderness Day
Univ. of Minnesota
Agricultural Extension Service
Institute of Agriculture
St. Paul 1, Minn. (Pay postage)

H. *Temperate Deciduous Forest*

I haven't found a film which covers this biome of eastern U.S. forest satisfactorily. Any tips would be appreciated. We use parts of:

Film:

Nature's Half Acre
Sd; color; 60 min. $10.00
Wm. M. Dennis

I. *Broad-leaved Sub-tropical Evergreen Forest*

For our single U.S. look at the subtropics, we end our cross-continental trip on the southern tip of Florida.

Film:

Birth of a Florida Key
Sd; color; 10 min. $6.00
Films of the Nations
62 W. 45th St.
N.Y. 36, N.Y.

III. *World Biomes*

The second week's tour of biomes outside the U.S. varies greatly from year to year, as we try new films that seem to hit ecological angles better than previously used ones. Some of the films which mix sociology and biology furnish a dandy takeoff for discussions of man's role in nature—colleague or autocrat? But it takes Scotland Yard sleuthing to track down films which stress biological rather than political or historical ends.

To warm up the student mind on world biomes, the second week's outside assignment

includes researching and filling in the biomes of Africa or Asia or Australia or South America or Europe (choice of two), on an 11" x 14" desk outline map, and indicating several dominant plants and animals in each biome. The examination which concludes the two weeks' unit covers all films, filmstrips, reports, discussions and map assignments.

Some useful world biome films are the following:

A. *Tropical Rain Forest Biome*

Filmstrip:

"Tropical Rain Forest"
Life Color Filmstrip
9 Rockefeller Plaza, N.Y.

Films:

Brazilian Rain Forest
Sd; color; 11 min.
Paul Hoefler Productions
7934 Santa Monica Blvd.
Los Angeles 46, Calif.

Guatemala
Sd; 20 min; $4.00
Univ. of Calif. 4088
(United World)
(Mahogany, coffee, bananas)

Cross-section of Central America
United World Films
(Chicle, mahogany, bananas)

B. *African Savannah Biome*

Films:

Animals Unlimited
Sd; color; 18 min. $6.00
Calif. Acad. of Sciences 1086
(Wm. M. Dennis, $6.)

African Fauna
Sd; color; 10 min. $2.00
Univ. of Calif.
(Bailey Films, Inc. $4.50)

C. *African and Asian Desert Biome*

Films:

Life in the Sahara
Sd; color; 15 min. $5.00
Univ. of Calif. 2707
(Encyclopedia Brittanica)

How Desert People Live
Sd; 10 min. $1.50
Univ. of Calif. 3550
(Knowledge Builders)

D. *Australian Biota*

Films:

Australia Today
Sd; color; 35 min. $8.00
Univ. of Calif., Los Angeles 24, Calif.
(Australian News and Info. Bureau)

The Koala
Sd; 10 min. $2.00
Calif. Acad. of Science 1025

E. *Altiplano Life*

Film:

Highlands of the Andes
United World Films

Tibet—Land of Isolation
Sd; 10 min. $1.50
Univ. of Calif. 2815
(Fitzpatrick)

F. *Asian Biota*

Films:

(Sociology & Biology blended)

The Ganges River
Sd; 16 min. $3.00
Univ. of Calif. 3087
(McGraw-Hill)

What Is China?
Sd; 23 min. $2.00
Univ. of Calif. 3991

Pakistan—Its Land and People
Sd; 17 min. $3.00
Univ. of Calif. 3083
(McGraw-Hill)

Japan—The Land and the People
Sd; color; 12 min. $3.00
Univ. of Calif. 4362
(Coronet)

G. *European Biota*

Films:

(Sociological touch again)

Mountain Farmers (Switzerland)
Sd; 20 min. $4.00
Univ. of Calif. 2928
(United World)

Forest Treasures of Sweden
Sd; 20 min. $1.00
Univ. of Calif. 3065
(USDA)

Scandinavia
Sd; 15 min. $2.00
Univ. of Calif. 4538
(Encyclopedia Brittanica)

Byways of France
Sd; 10 min. $1.50
Univ. of Calif. 2919

Italy, Peninsula of Contrasts
Sd; color; 17 min. $5.00
Univ. of Calif. 4226
(Encyclopedia Brittanica)

Iberian Peninsula
Sd; 10 min. $1.50
Univ. of Calif. 5018
(Encyclopedia Brittanica)

H. *Pacific Islands*

Films:

Manna of the South Seas

Sd; color; 20 min.
Martin Moyer Productions
900 Federal Ave.
Seattle, Wash.
(Coconut harvest on Tahiti)
Hawaii: U.S.A.
Sd; color; 21 min. $4.50
Bailey Films, Inc.
Free films on Hawaii available from Pan American Airlines and Standard Oil Co. of Calif.
(glamourized but descriptive)

In my opinion, there is a strong need in biology for a good film, or preferably, series of films, on biogeographical and biotic regions of the world—and their flora and fauna. One has to scour every catalog he can find at present to discover films or filmstrips that will do the job—and some of them do it only halfway.

But it's worth a try! Not long ago I heard indirectly how Judy D., one of our ex-biology students who had never been outside the state before, had amazed and delighted the other students and teachers in her car on a convention trip from California to New York with a "play-by-play" account of the biomes they passed through. Lilts of pleasure like this make up for the kids who'll forget every film they saw, and every map they worked on, and every biome they ever heard of.

On the whole our students go for this unit in a big way. Last semester a colleague stopped me in the hall one day and asked, "What are you on in biology now?"

"Bio-geography."

"Well," he grinned, "I happened to overhear two of your girls talking in the corridor just now. One said to the other, 'I like this unit best of all—except Reproduction'!"

Film Sources (Mentioned more than once)

Bailey Films, Inc.
6509 De Longpre Ave.
Hollywood 28, Calif.

California Academy of Sciences Film Library
Golden Gate Park, San Francisco, Calif.
(serves schools Arizona and westward)

Encyclopedia Brittanica Films
Wilmette, Illinois

United World Films
1445 Park Ave., New York 29, N.Y.

University of California—Dept. of Visual Instruction
University Extension
Berkeley 4, California
(Serves schools Arizona, Colo. and westward)

Wm. M. Dennis Film Libraries
2506½ W. 7th St.
Los Angeles 57, Calif.

References

1. Bayer, *World Geographic Atlas.*
2. Brown, Relis, *Biology.* D. C. Heath & Co., N. Y., 1956. (U. S. biome map and chapter on biogeography)
3. Drimmer, *The Animal Kingdom.* 1955.
4. Encyclopedias. Very useful in map research. Look up the continent you want and check subheadings on fauna and flora. Also look under vegetation types and animal distribution general headings, and under the name of specific plants and animals.
5. Hegner, *Parade of the Animal Kingdom.*
6. Jaques, Harry, *How to Know the Trees.* W. C. Brown Co., Dubuque, Iowa. (U. S. tree ranges.)
7. Jordan, *Hammond's Nature Atlas of America.*
8. Martin, Zim, and Nelson, *American Wildlife and Plants.* McGraw-Hill, N. Y. (Animal and plant distribution ranges.) 1951.
9. Newbigin, *Plant and Animal Geography.*
10. Odum, Eugene P., *Fundamentals of Ecology.* W. B. Saunders Co., Phila. 1953. (Biome maps of N. America and Africa; biota of N. American biomes described, chap. 11.)
11. Oosting, Henry, *Plant Communities.* W. J. Freeman Co., San Francisco, 1950.
12. Packard, *Geography of the World.*
13. Pettingill, Olin S., *A Laboratory and Field Manual of Ornithology.* Burgess Pub. Co., Minneapolis, Minn. 1946. Biome map of N. America.)
14. *Rand, McNally Atlas*—Vegetation maps of world.

BOOK

DARWIN'S CENTURY, Loren Eiseley, 378 pp., $5.00, Doubleday & Company, Inc., New York, 1958.

An easily readable survey of the men who created many of the ideas important in evolution who lived preceding and during the century in which Darwin lived. This is the type of history of science which puts Darwin and his great work in the context of ideas which were important in the genesis of the theory of evolution. The fields of biology, physics, and geology are carefully surveyed for their contributions. Even many other "idea" men are described in this careful analysis. High school teachers will find this a valuable reference for their own education as well as supplementary reading for high school students studying evolution. It should prove the type of reading which will make the great idea of biology much more understandable.

Biology — An Anomaly

GEORGE GREISEN MALLINSON

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The Science Program in Turmoil

Since October 4, 1957, with the launching of the first satellite into orbit, the hue and cry for a re-evaluation of the program of science education in the United States has reached fantastic proportions. It would seem indeed that there is little need for further emphasis of the subject. Many of the loudest demands proclaiming the need for changes arise from persons who insist that they have been the pioneers in identifying the ills of science education, dissipating the clouds obscuring the problem, and proposing the correct solutions. It is, however, important to point out that the problems facing education, and science education in particular, have been identified and publicized for many years. Those who have been working with and investigating science education have not been "given the light" by the self-appointed evangelists. Rather, they have been victims of a generalized apathy toward the problem. That apathy is now being replaced by the frantic efforts of many persons to do something about the situation. Unfortunately, much of the "doing something" is in the wrong direction.

Probably never again will attention be directed so sharply on science education as it is now. Hence, it behooves all persons really familiar with science teaching and who have studied it carefully over the years to take advantage of the opportunity to move forward in the right direction. Otherwise, some mad lumberman may rush into the forest with a torch and burn down everything in his quest for wood.

In view of the opportunity, the writer would like to point out certain facts about the program of high-school biology, and make certain proposals for its modification.

Biology for Whom?

There have been many studies undertaken during the past few years dealing with the status of biology teaching in the United States. Nearly all these studies indicate that about two-thirds of all high-school students take biology. In some schools, it is elective; in others it is required. Nevertheless, no matter how one may view the reasons for the large enrollments in biology, it is clear that a cross-section of the typical student body is found in the course. In other words, biology is for everybody. Yet, the connotation of "everybody" needs to be examined and certain questions need to be answered. For what purposes do the students take biology other than the fact that they must have a "laboratory science" for graduation? What function is the course in biology expected to serve? Unfortunately, from observation of many biology classes, the writer believes that little attention is paid to these questions. If answers are sought, and obtained, biology is seldom taught in a manner consistent with the implications of the answers. If one examines carefully the average class in biology in the typical high school in the United States, one startling fact stands out. In such a group of 40 students, 36 will never again take another course in biology. Of the four who do take another course, only one will take more than the introductory course in college biology.

These data are substantiated by both empirical analysis and theoretical computation. Empirically, follow-up studies of high-school students with respect to their later attendance at college and the courses they take, support the facts just stated. Theoretically, one may compute the number of students who take high-school biology, the number who enter college, and finally, the number who take and continue in biology in college. The 36 to 4 ratio is still supported. Whether one likes it or not, the typical course in high-school biology belongs merely by weight of numbers to those who do not intend to be biologists! Hence, it is difficult to assume how the endless hours spent in a systematic study of plant and animal structures and in butchering plant and animal cadavers will be of much profit to those students for whom the course is

terminal. Frankly, there are those who would question the value of such activities even for students who intend to enter biological professions, at least in so far as the first course in high-school biology is concerned. Yet, unfortunately, much of high-school biology in many schools is occupied with these activities.

If, then, there are some doubts about the values of the typical biology course, one may legitimately ask what purpose it should serve. In terms of the anomalies described above, some re-evaluation and some recommendations obviously need to be made.

Realistic Biology Teaching

One cannot discuss a program of biology in the high school without examining the total science program in the secondary school. During the past few years, there has been an increasing doubt of the need for general science in all the junior-high-school grades, namely, seventh, eighth, and ninth. The overlap of the topics studied at these three grade levels is extremely great. Further, many items dealt with in elementary science cover what formerly was studied in general science. Hence, students often get three doses of the same subject matter, once in the elementary school, again in grades seven and eight, and again at the ninth-grade level. It would seem, therefore, that ninth-grade general science may well be dropped in order to relieve the student from endless repetition. The writer wishes to suggest that the present course in biology, taught in most schools at the tenth-grade level, may well be placed at the ninth-grade level and designed to suit the needs of the overwhelming majority of students who elect it.

At present, the typical course in high-school biology serves adequately neither the college-entrance nor the non-college entrance student. The great amount of time spent on memorizing invertebrate structure is a waste of time to the student for whom biology is terminal. For the student who intends to continue in biology, it is doubtful whether the course, studied at a grade level when his intelligence is still immature, will have any substantial carry-over value for the college program. There is ample evidence in the literature of psychology of learning to support these points. In order to resolve the paradox there needs to be some change in the present biology program.

1. There needs to be *two* different biology courses, one designed for the functional training of students in biology and one designed for the systematic training. The writer does *not* suggest that these should be *options* at the ninth- or tenth-grade level. At these levels it is not reasonable to expect that students are sufficiently well oriented to decide whether they will be professional or non-professional biologists. The writer believes that a biology course, functional in nature, be provided *for all students* at the ninth-grade level and a second-level course, with a systematic emphasis, in advanced biology, be made available as a later elective, preferably at the twelfth-grade level. This advanced course will be *in addition to, not in place of*, the functional course. Some teachers will no doubt state that they cannot teach an adequate course in biology at the ninth-grade level to potential college-entrance students. The writer would agree but also believes that these teachers cannot teach an adequate course in college-entrance biology to tenth-grade students either. Hence, it might be well to forget about college-entrance biology at the ninth- and tenth-grade levels.

Why Biology in the Ninth Grade and What is Meant by "Functional"?

The ninth-grader, generally experiencing the pubescent spurt and the onset of adolescence, becomes personally oriented in his thinking and more concerned with himself as a biological mechanism. Hence, from this point of view, a biology course is admirably timed. Further, if the ninth-grade course in general science is dropped as suggested earlier, it would seem reasonable that the course in general biology could be taught at this level. It is in fact so taught successfully in a number of schools. Such a move would leave the tenth grade open for the general physical science course that is now being advocated widely. In such a program, no *new* courses are added, nor is more time requested for science. Rather, the present time is redistributed. This certainly should allay the concern of those who believe that "science" is ready to take over the curriculum of the high school.

A functional program of biology should not be confused with the term "practical." Practical biologies have been little more than exercises in first aid, the use of insecticides, to-

gether with numerous admonitions to get eight hours of sleep per night and drink at least eight glasses of water each day. A functional course is built around a study of the *functions* that living things must carry on in order to survive. Such a course avoids teaching biology in terms of the structures of representative members of the plant and animal phyla together with the accompanying microscopy and dissections. Rather, the units are based on broad areas of study such as, "The need for and utilization of energy for survival," "The constant struggle among different species for the available energy," "The need to reproduce in order for species to survive," and "The limitations of biotic resources that make conservation necessary." Actually, most of the present elements of subject matter would be retained by reoriented to teach the ideas described above, rather than organized to teach structure.

It is not difficult to argue that such a program of biology is far more suitable as an introductory course than a study of plant and animal structures with which the *vast* majority of students will never come in contact.

College-Entrance Biology

The writer suggests that the program described above is eminently suitable at the level indicated for *all* students in terms of their role in the living world. However, neither this biology nor any other one taught at the ninth- and/or tenth-grade level is sufficiently rigorous to be assigned the name "college entrance." The writer believes that a senior-level course, perhaps called "Advanced Biology" (as it is now called in many schools having the offering) designed to pick up where the functional course left off is the answer for college-entrance students. Such a course should be rigorous and place emphasis on the systematic approach. Such a course at the senior level should have far more carry-over than one taught at the tenth-grade level. The reasons are obvious.

The writer believes firmly that the program described above will be far more suitable than the one commonly found in the public schools. It should assist in elminating the anomalies now existing in the present program of high-school biology.

Student Teaching — Family Style

JEANNE BUCK
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Was daily student teaching, in addition to the responsibilities of husband, house, and three sons under the age of three-and-a-half years, too much to tackle? Some of my friends said yes, and there were times during the semester that I agreed with them. But I had not been teaching more than a week when some of the hidden advantages of my unusual situation began to appear.

I had been trying to think of some new way to teach the concepts of digestion to my students, who were completely innocent of chemistry, when the baby became sick. Just a stomach upset, but the only way to quiet him was to sit down and rock him and ignore my carefully planned schedule. As I rocked the now-quiet child, my eyes surveyed the toy-strewn room. There were those awful little blocks someone had given the oldest boy. They were not big enough to build anything satisfactory, but they were quite large enough for people to fall over! Brightly colored shapes, some with holes for the long yellow dowels my children preferred to use as clubs. Useless toys—or were they so useless—could they be used to help my students comprehend digestion? Perhaps a yellow dowel thrust through a bright red block could represent an amino acid, the end product of protein digestion. Add a blue rectangle, another dowel, a couple of solid green bars, and the resulting structure could represent a big protein molecule before digestion. Remove the pieces, showing digestion taking place, and end up with the original yellow dowel in the red block. Promising . . . ? Maybe.

How about carbohydrates and starches? Quick, take one of those miniature logs from the dump truck. This represents a molecule of glucose, the end product of starch and carbohydrate digestion. Attach a few stray blocks in various colors to represent the original food—a candy bar, potato, or bread, for instance.

Now for fats . . . ah, those "chicken-in-the-egg" sets look promising. Can't find two whole

eggs? Never mind. Take a big red half-egg and a medium sized green half-egg. Fit one inside the other to make a fat molecule. Take them apart to show the breakdown to fatty acids and glycerol. Oversimplified? Not at this stage of the game.

In class next day, after agreeing on the representative structures for the end products of digestion, we sat Horace, the human torso model, on the front desk and proceeded to feed him various succulent items suggested by the class. Horace first had a piece of steak, which, of course, was the colorful structure of blocks and dowels. The students followed the progress of the "steak" through the digestive tract, watching with rapt attention how the protein broke down at appropriate places under enzyme action until it was reduced to amino acids, or a plain old yellow dowel with a red block, ready for absorption.

We went through this process, using the different models for carbohydrates, starches, and fats, referring frequently to a detailed enzyme chart on the board and a large colored drawing of villi, to show the paths our little models took next. The class enjoyed giving the play-by-play description of the digestion of various items of food common to the teen-ager diet and, to my intense gratification, retained the concepts on the test a couple of weeks later. My poorest student called me over during the exam and said in great earnestness: "I just can't remember the name of the thing that those proteins break down to, but it looks like a yellow stick with a red block on it." Did he pass? Of course he passed.

Once having tasted success, everything in my home became potential teaching material.

Problem: You need large colored drawings to supplement the text, but you have no easel, no clipboard, and the bulletin board is already full. Solution: String a ten or twelve foot piece of wire in a convenient part of the classroom, draw your pictures on pieces of ordinary rolled shelving paper with children's crayons, attach drawings to wire with ordinary clip clothes pins, hanging a few on the bottom of the pictures so they don't curl. Drawings such as these are quick to make, highly visible in all parts of the room, and cheap. Remember to take the clothes pins home or you'll be hanging out the diapers double.

Problem: You have managed to obtain a beef pluck gratis from a cooperative meat packer, but you won't be ready to use it in class for another week. Solution: Park it in the freezing compartment of the refrigerator but, no matter how well it's wrapped, choose its position carefully. One of your more observant students will undoubtedly ask you, "Say, teacher, do all plucks smell like ice cream?"

Problem: You have some choice *Drosophila melanogaster* stock, donated by an interested geneticist, and you want to prepare enough mating bottles so all the students can have six pairs of flies to raise. The flies must be transferred from the stock bottles at just the right time. Otherwise they will mate with one another instead of the mates you have in mind. Your students will find great discrepancies between theory and fact in their results, and there go some more disillusioned biology students over to humanities. . . . Solution: Put the flies on the baby's schedule, or the baby on the flies' schedule, the former being simpler. Then, at 2 A.M. you bottle one and pair the others, being sure to clear the stock bottles for a repeat performance at the 10 A.M. feeding. Think of the fun I would have missed living in a dormitory.

Home was an unexpected gold mine, but school worked to the benefit of the home as well. Problem: Who is elected to board the guinea pigs during vacation, since the students' mothers have put their collective feet down against importing additional livestock? Solution: Why, the student teacher, of course, whose middle son is a bit afraid of animals; perhaps his fears might be tempered by association with the gentle guinea pigs. And has his attitude changed for the better? Well, we thought we were making headway when he looked downcast after the guinea pigs returned to school. We were encouraged when he started sharing his meals with the backyard birds and squirrels. We were thrilled when he started dragging into the house beetles and caterpillars in various stages of maceration to be put into jars and gazed at awefully. But when he solemnly led a ponderous neighborhood St. Bernard into the kitchen and fed it the hamburger earmarked for dinner, we had to conclude that his association with the guinea pigs has had a definitely positive effect on his attitude toward animal life.

Student teaching—family style—has much to recommend it!

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Improvisation of Bacteriological Equipment*

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One area that is often neglected in the high school biology course is that of bacteriology. Bacteriology is an area of biology where the scientific method may be taught most effectively. Every student can be included in the exercises assigned with assurance that they all will have success with their experiments. Another value of teaching bacteriology in the high school biology class is that an understanding of the relationship of man to both helpful and harmful bacteria may be gained.

The average high school biology teachers neglect to teach a unit on bacteria because they either feel that they are insufficiently prepared or that their school lacks the expensive equipment necessary to teach such a unit. The needed preparation will be confidence in your teaching ability and an investigative spirit with which to lead your students in conducting experiments. Concerning expense, approximately ten dollars will give any school the necessary equipment for teaching a unit on bacteriology.

The first thing necessary for making a study of bacteria is some media upon which they will grow. The best media that may be used is a powdered variety that can be obtained from any biological supply house, but it is somewhat expensive. There are many substitutes that may be used instead of this commercial media; they are potato, carrot, plain gelatin, or oatmeal. All of these media will work but are not as efficient as the commercially prepared material.

Some means of containing the culture material is now needed. A Petri plate is the most efficient thing to use. Petri plates can be obtained in glass which is expensive, easily broken, and a problem to sterilize and clean. New plastic Petri dishes are now on the market, but these involve more expense than the average high school can afford. Aluminum foil Petri dishes are the answer to the high school teacher's problem.[1]

Sterilizing the material used in teaching a unit on bacteriology should be no problem for the high school teacher who is able to use the school home economics facilities. The media may be sterilized in a pressure cooker, and the other materials may be sterilized in a regular oven.

The lack of an incubator is usually the biggest hindrance to teaching a unit on bacteria at the high school level. A sturdy, efficient incubator, that can become a permanent part of the laboratory equipment, can be made from a three gallon frozen fruit can, some electrician's wire, two lamp sockets, one plug, two light bulbs, two pieces of two-by-four used for a stand, one thermometer, and one bi-metal strip thermostat. The last two can be obtained from any supply house, and the rest from a locker plant, hardware store, or lumber yard. The incubator is wired in series. The construction of such an incubator makes a very fine club project for a neophyte science club group.

An incubator of this type has many uses in the classroom other than culturing bacteria. It can be used to hatch chickens, dry plants, or as a warming oven for many biological projects.

For a new experience in biological enthusiasm, try a unit on bacteriology filled with experiments containing unknowns which will stimulate both you and your students.

*Presented to the NABT section of the AIBS meetings at Indiana University, Bloomington, Indiana.

[1]Fagle, David L., "Another Use For Aluminum Foil" *The American Biology Teacher*, October 1956.

A Short History of Anatomy and Physiology from the Greeks to Harvey, Charles Singer, 209 pp., $1.75, Dover Publications, Inc., New York, 1957.

A new paperback edition of a classic work. Reviews history from prehistoric man to Harvey. Liberally illustrated. Valuable for teachers interested in the historical approach to biology.

Inexpensive Teaching Materials and Project Ideas

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I discovered the value of scrap cardboard, broken window panes, and baby food jars through successful attempts to supply my biology classroom with low-cost teaching models and materials, to provide my students with ideas for projects to prove or increase their understanding of biology, and to develop methods to be passed on to or shared with other teachers with similar problems.

The supply houses have long recognized the value of oversized models of organisms or their parts and the desirability of uniform containers for preserved materials which are used for study and display. They have been unable, however, to manufacture or present many of these materials at a cost that would enable many high schools with limited budgets to provide classrooms with more than one or two such models or more than one set of uniformly mounted speciment.

The students usually associate the word "project" with additional work to be done for credit involved rather than with the opportunity to express themselves through interest in their work. The former idea is being slowly expelled and the latter is taking its place in my classroom.

Model Making

My first attempt at model making, described below, resulted in a frog that was not only useful and adequate in the study of that animal, but was also extremely fascinating to the students. The enthusiasm of the students was evidenced by the number of friends they brought to see the model and by the various voluntary projects that were patterned after it.

Using a Turtox Animalkin of the leopard frog, I transferred a likeness of the external view by means of an opaque projector to a piece of uncreased cardboard, 4′x6′. The cardboard had been obtained from cartons which had contained school furniture. Using enamel paint which covered well and dried quickly on the cardboard, I painted the pencil lines and spots black and all other parts gray-green and then allowed the picture to dry. Using a Xacto knife, which I introduced into my classes as a scalpel because of its equal effectiveness and smaller cost, I cut out the painted outline, and painted the reverse side with black enamel.

I transferred the skeletal system to white poster board, outlined it in India ink with a wide-pointed pen, cut it out, and, bone by bone, except for the skull, glued it to the solid black surface of the frog. The contrast of the white on black was vivid, and the thickness of the posterboard resulted in a three dimensional effect.

I drew each internal organ in relative size on cardboard, painted them in life-like tones, and cut them out. Using paper tape and paper clips, I made hooks and eyes of various designs and fastened these to the organs. By hooking the organs into place over the skeletal system and over one another, I managed to give the resulting layers an extremely realistic depth. The organs could be seen in relationship to one another and could be removed one by one for examination and discussion.

A final innovation was the mouth. I sketched the open mouth with all of its openings and parts on poster board, cut it out, and folded it at the jawline. After gluing the upper jaw permanently to the underside of the head, I fashioned a tongue from poster board, attached it with a paper hinge to the front of the lower jaw, closed the jaw and held it shut with a hook. I then painted the exposed surface of the lower jaw black and glued the skull bones on it, completing the skeletal system. When the hook was released, the lower jaw opened and the tongue flipped out in a realistic manner. This action thrilled the students who always enjoy something humorous to brighten up their lessons.

The color and size alone were attention-

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capturing aspects of this model and its practical value for teaching makes it a must in my classes.

Framed Mounts

I have often admired the lovely butterflies, moths, and other fragile specimens mounted in the glass-topped Riker boxes. The appealing factor of a Riker mount is the ease with which it may be passed around for examination without damage to the specimen. Having a number of specimens that were getting quite badly beaten from the students' examinations, I decided there was no reason why I could not improvise a mounting for them. I begged all the remains of broken window panes from the janitor and, using a glass cutter, which was far easier than I had imagined, cut rectangles of glass of the proper size to cover the specimens. I then made a frame of balsa wood which was used to separate the two glass plates and thus to prevent mashing of the specimens. I used balsa wood because it can be cut and trimmed easily. After gluing this frame to one glass plate with airplane glue and placing the specimen inside the frame, I used a tiny drop of glue to fasten it to the glass surface so that it would not fall about when examined. This was covered by the second glass plate which I glued into place. To prevent fingers being cut by the sharp edges of the glass, I bound the edges of the mount with masking tape to give a neat-looking, well-protected specimen that could be studied from top and bottom. I labeled one taped edge so that when the uniform mounts were stacked for storage it was easy to see just where the ones I wanted were located.

Uniform Collections

I had in the storeroom many odd-sized bottles and jars, half-filled with preservative in which specimens were floating or lying at the bottom in a most unattractive manner. Seeing a pile of discarded baby-food jars and their lids suggested to me a method of mounting these specimens in uniform bottles in a way that would be pleasing to the eye. Gathering these, I found that a microscope slide would just fit in the jar. By tying specimens with a thread to a microscope slide or mounting the smaller specimens on the slide with gelatin, I discovered that they would remain in full view of the students without having the bottles tipped or shaken. Painting the lids with black enamel and having each jar filled with preservative resulted in a neat, uniform, inexpensive and attractive display of specimens. The students are still collecting both specimens and jars to complete teaching sets of one specimen jar for each animal studied for each table.

The methods and materials here described are available to any teacher or student, and for this teacher have resulted in a better organized biology classroom.

Biology in the News

Brother H. Charles, F.S.C.
St. Mary's College, Winona, Minnesota

WHAT YOU SHOULD KNOW ABOUT SELF-TREATMENT DRUGS, Ruth and Edward Brecher, *Redbook*, September 1958, pp. 28-31, 86-88.

Hundreds of questionable medical products are being sold to take advantage of your desire for quick relief or cure. Despite the efforts of reputable drug companies and three government agencies it is often difficult to tell the difference between reliable and unreliable products. This article gives many facts which will help you identify those which are worthless.

SUN WORSHIP IN 1958, Roy Harrity and Richard Craven, *Cosmopolitan*, June 1958, pp. 64-69.

Are you one of those sun tan seekers who knows little of what the sun is doing to you? This article tells you how to develop a pleasing tan without too much harm to your skin.

SCHOOL FOR YOUNG WADERS, Evan Hill, *Saturday Evening Post*, August 16, 1958, pp. 25, 70-72.

Children are most curious about living things if they have the right leader. Here's how some teachers really lead.

THE USES OF VINEGAR AND HERBS, Frank F. Taylor, *Saturday Evening Post*, September 13, 1958, pp. 36, 130-132.

Foods can be made more appetizing by the use of strange objects such as orchid seeds and juniper berries.

BIG CITY'S PRIMITIVE FOREST, Milton Mackaye, *Saturday Evening Post*, September 13, 1958, pp. 38-39, 66-74.